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RESULT

OF

TWO SERIES OF EXPERIMENTS

TOWARDS ASCERTAINING THE RESPECTIVE

VELOCITY OF FLOATING BODIES,

VARYING IN FORM;

AND TOWARDS DETERMINING THE FORM BEST ADAPTED TO

STABILITY,

OR POSSESSING MOST POWER OF RESISTING THE FORCE OF THE WIND IN

CARRYING SAIL:

INTENDED TO CONVEY USEFUL HINTS TO THE CONSTRUCTORS OF SHIPS;

WITH OBSERVATIONS:

IN A LETTER TO THE SOCIETY FOR IMPROVEMENT OF NAVAL ARCHITECTURE.

K–

By CHARLES GORE, *Eſq.*

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TO THE

SOCIETY

FOR THE IMPROVEMENT OF

NAVAL ARCHITECTURE.

GENTLEMEN,

I BEG leave to preſent to You and the Public the Reſult of a Series of Experiments, towards aſcertaining the comparative Reſiſtance of the Fluid Water on floating Bodies of different Forms, applicable to the Conſtruction of Ships.

Theſe Experiments were conducted under the Inſpection of *John Hallett*, Eſq. and myſelf, by *Mr. Hayward*, lately, and for many Years, in the Employ of Meſſrs. *Wells*, as a confidential Aſſiſtant. And having availed myſelf of your kind Permiſſion, by making Uſe of the moſt excellent and appropriate Apparatus, contrived by the Ingenuity, and erected at the Expence of your Society, at the Greenland-Dock, I may venture to vouch to You and the Public, for the Accuracy and Preciſion of the Proceſs. I therefore ſubmit theſe few Sheets to your Inſpection and Inveſtigation, previous to the Publication of that more extended and laborious Series, which has been conducted with ſo much Ability and Application by the Gentlemen of your Committee; the Reſult of whoſe meritorious Exertions is ſo anxiouſly and impatiently expected by the World. I cannot harbour the ſuppoſition that my Experiments will ever be conſidered as having been undertaken with an Idea of Competition to thoſe of your Society; but on the contrary, as the Public Good is the object of both, I ſhould rather hope, that the former, more contracted, will be conſidered as the Harbinger of the latter, more extenſive. I muſt alſo add, that if the Reſult of the Two, tried independent of each other, and varying in the Modes of their Proceſs, ſhould agree, ſuch agreement muſt conduce to mutual Confirmation: and that they will agree I have little doubt, from the Communication I have had the honor to receive from the above Gentlemen, who, upon a much larger Scale, have extended their Enquiries to the Inveſtigation, not only of the Effects, but alſo of the Cauſes, which had hitherto eluded the Labour and Application of many Scientific Men.

I muſt here obſerve, that from the Authenticity of theſe documents it appears, that the firſt principles of Naval Architecture have been hitherto unknown; that the Science is yet in its Infancy, and that a Field is opened for Speculations tending to a thorough Reformation in the Art. From theſe Conſiderations I hope, that in time, thoſe abſurd Maxims which have ſo long governed the Conſtructors of Shipping, will ſubmit to Refutation, and be laid aſide ; though I fear they ſtill boaſt too many Advocates, who cannot conſent to acknowledge themſelves in the wrong, or will not take the trouble to ſearch for the ſeat of their Error. I truſt, however, that from what is demonſtrated by the following Plates, and the Explanation thereof, the abſurdity of the preference which prevails in favor of that Form, which is vulgarly denominated the Cod's Head and Mackarel Tail ; and the erroneous Idea, which has been ſo long and ſo generally entertained, of a Spar towing with more eaſe when the Butt-end is foremoſt will be amply refuted, eſpecially when it has been proved, by one of the manifold experiments made by your Committee, that the ſmall End foremoſt, with the ſame motive Weight, exceeded the larger in Velocity as 38,75 to 27,75 This alſo confirms the Reſult of an Experiment made by me, the account of which I had the Honor to tranſmit to you ſome time ſince. From theſe Facts I ſee great reaſon to hope, that the time is not far diſtant when the Labours of your Society ſhall be crowned with Succeſs, in expelling thoſe abſurd and fallacious notions to which Seamen and Shipwrights have ſo long been held in ſubjection. And I truſt the accompliſhment of this moſt deſirable purpoſe will be much accelerated by the Exertions of a Gentleman, whoſe Fund of Science, and truly mechanical Genius, together with his unremitting Application and Induſtry, will, I make no doubt, ultimately prevail over that Torrent of Prejudice in Favor of old Syſtems, with which (like moſt promoters of Improvement) it is his Lot to contend; and it will be demonſtrated to the World, that the Station of great Reſponſibility with which he is inveſted, has not been unmeritedly beſtowed.

It will be found, by the Table in the annexed Plate, that the different Forms, being all drawn by the ſame motive Weight, viz. 1-½lb. varied in their Velocity as follows, in Feet per Second.

Fig. 1. Exceeded.

Fig. 2. By ,053 each of them weighing 25*lb*. 4*oz*.

Fig. 3. Though weighing 28*lb*. 8*oz*. exceeded *Fig*. 1 by ,277

Fig. 4. Being ſimilar in Form to *Fig*. 3 with the addition only of a little Fulneſs forward, as per Plate, which encreaſes its Weight to 29*lb*. 4*oz*. loſes in Velocity only ,106 which is ſuppoſed to be counterbalanced by the Power of additional Canvaſs, which this Augmentation would enable the Ship to carry.

Fig. 5. Has a further Addition forward as appears by the Plate, and its Weight encreaſed thereby to 30*lb*. 8*oz*. yet loſes in Velocity only ,051 by the laſt Increaſe, though it ſtill exceeds conſiderably *Figs*. 1 and 2, notwithſtanding 5*lb*. 4*oz*. Increaſe in the Weight.

Fig. 6. Is ſimilar to *Fig*. 5, with the Addition only of a Sharp Beak forward as per Plate, which though it increaſes the Weight to 32*lb*. 8*oz*. brings the Velocity equal to *Fig*. 3 within ,076 notwithſtanding the conſiderable Increaſe in Capacity, and conſequently in Stability. Here it will be obſerved, that the Extreme Breadth is abaft the Center.

Fig. 7. Is ſimilar to *Fig*. 2, except that the Line in the after Part is hollow inſtead of round, which reduces the Weight to 23*lb*. 8*oz*. being 1*lb*. 12*oz*. leſs than *Fig*. 2, and thereby brings the Velocity to exceed that of *Fig*. 2 by ,111 which is ſuppoſed unequal to the Defalcation of Capacity, and conſequent Stability. It is alſo certain that this Form would be ſubject to more Oſcillation in a Sea, by reaſon of the great Inequality of the two Ends, whereby the eſſential Counterpoiſe is deſtroyed, and it follows therefore that the Velocity muſt be diminiſhed, as it cannot be doubted but that the Veſſel which is neareſt balanced in the Sea will oſcillate or pitch leſs, and muſt conſequently, *cæteris paribus*, be from thence capable of greater Velocity.

Fig. 8. Being *Fig*. 7, reverſed, *i.e.* the ſharp End foremoſt, loſes thereby ,030 It is obſervable alſo, that this figure being ſimilar to *Fig*. 1, with the variation only of the Line in the fore part being hollow inſtead of round, gains in Velocity, compared to *Fig*. 1 ,028 Though this Increaſe in Velocity ſeems to be produced rather by the decreaſe of Weight than by the Variation of Form.

Fig. 9. Is *Fig*. 4 reverſed, by which the Velocity is increaſed ,056 This demonſtrates that Fulneſs abaft to a degree, obvious to a critical Eye on Inſpection of the Plate, does not impede the Motion through the Water.

Fig. 10. Is *Fig.* 5 reverſed, by which the Velocity is diminiſhed ,096 Here the Fulneſs abaft ſeems to be carried too far.

Fig. 11. Is *Fig.* 6 reverſed, by which the Velocity is diminiſhed ,047 This ſhews that the after part is here alſo too round. Here it will be obſerved that the extreme Breadth is before the Center.

Fig. 12. Is *Fig.* 11, with the ſame Addition forward as abaft, by which it loſes in Velocity only ,202 a loſs whoſe ample Compenſation will be found in the Addition of Capacity, and conſequent Ability to carry Sail.

Fig. 13. } Are ſimilar on the horizontal Plane to *Fig.* 12, but
14. } rounded on the perpendicular Plane at one End. *Fig.*

13, with the rounded end Foremoſt, exceeded *Fig*. 12, in Velocity ,328 which fully compenſates the ſmall Defalcation of Capacity. *Fig*. 14, with the rounded End aft, looſes in Velocity, compared to *Fig*. 13 ,254 This furniſhes an additional Argument in Favor of placeing the Sharpneſs forward.

Fig. 15. Is ſimilar to 14, but with both Ends rounded, by which Alteration it gains, in Compariſon with *Fig*. 14 ,692.

Fig. 16. Is a Parallelepipedon, weighing 26 *lb*. 8 *oz*.

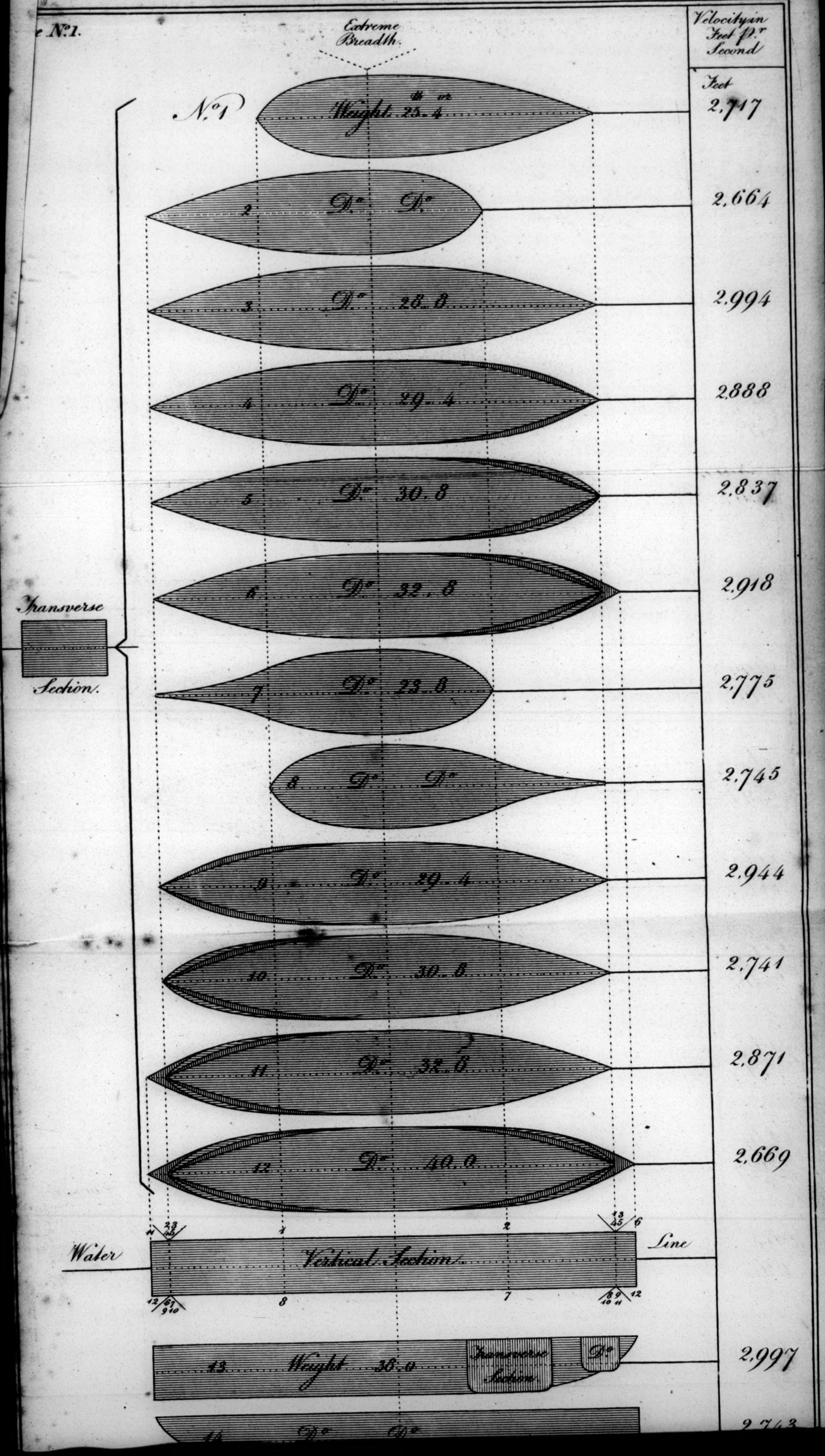
Fig. 17. Is likewiſe a Parallelepipedon, of the ſame Breadth and Depth, but having the Length doubled, and weighing 54 *lb*. notwithſtanding which Increaſe in Length and Weight, the Diminution in Velocity is only ,071 This clearly demonſtrates the great Advantage derived from Length.

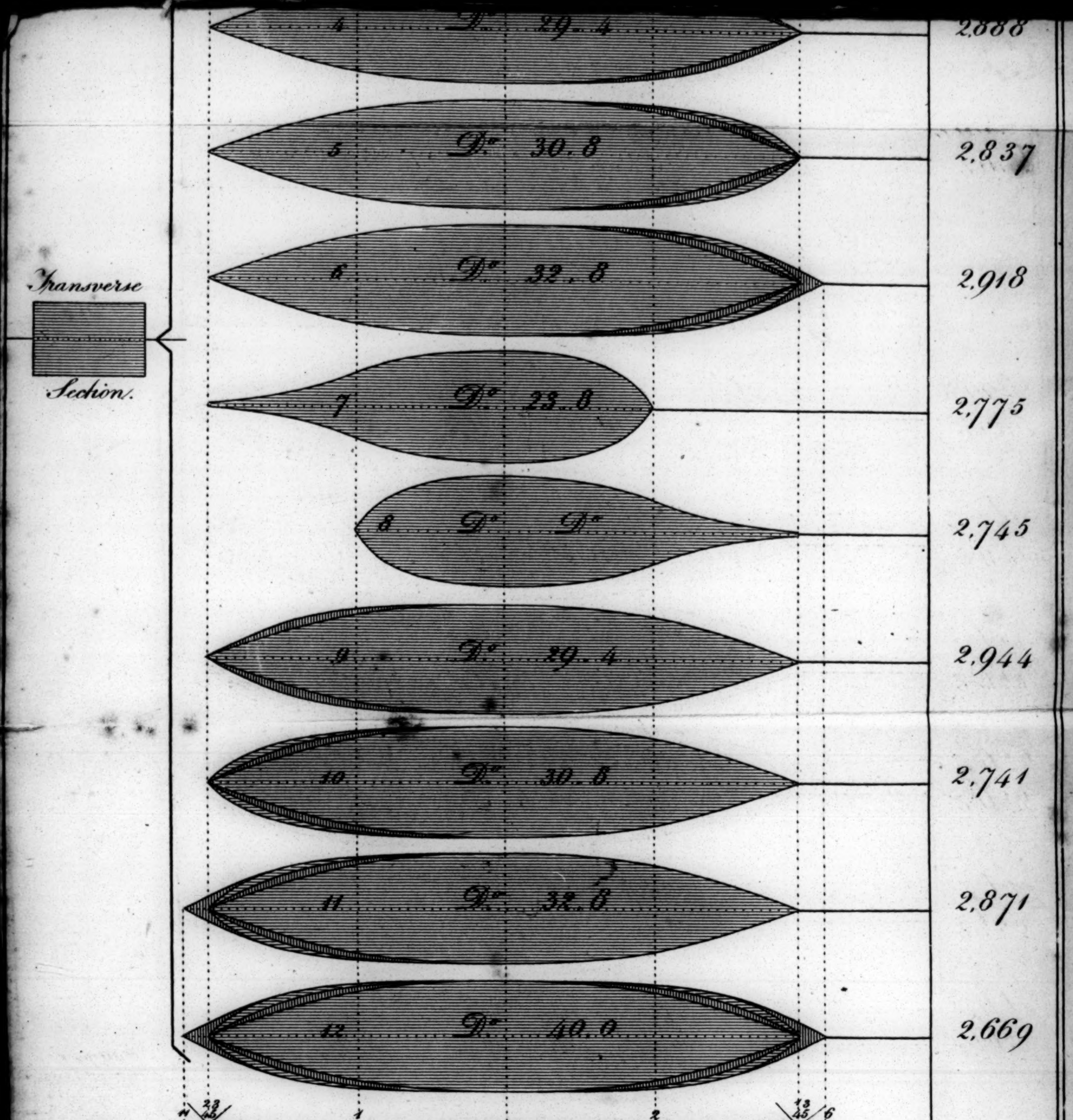
Fig. 18. Is alſo a Parallelepipedon, weighing 50 *lb.* 12 *oz.*

Fig. 19. Is another Parallelepipedon, ſimilar in Length and Breadth, but double the Depth, and weighing 101 *lb.* 8 *oz.* This loſes in Velocity with Compariſon to the former ,476 which proves that the Reſiſtance is encreaſed more by the Addition of Depth, than by that of Length.

From the Reſult of the foregoing, it ſeems to appear, that the Form beſt calculated for Velocity, is a long parallel Body, terminating at each End in a parabolic Cuneus, and having the extreme Breadth in the Center. Alſo, that making the Cuneus more obtuſe than is neceſſary to break with Fairneſs the curve Line into the Straight, creates a conſiderable Degree of Impediment. And, I am inclined to think, from what I have ſtated, that the Length of Ships, which has already been extended with Succeſs, to 4 Times the Breadth; is capable, with Advantage, of ſtill further Extenſion, perhaps to 5, and, in ſome Caſes, even to 6 Times.

e N.º1.


Extreme Breadth
Velocity in Feet p.r Second
Feet
N.º 1
Weight lb oz 25..4
2,717
2 D.o D.o
2,664
3 D.o 28..8
2,994
4 D.o 29..4
2,888
5 D.o 30..8
2,837
6 D.o 32..8
2,918
Transverse Section
7 D.o 23..8
2,775
8 D.o D.o
2,745
9 D.o 29..4
2,944
10 D.o 30..8
2,741
11 D.o 32..8
2,871
12 D.o 40..0
2,669
Water Vertical Section Line
11 23 45 1 2 13 45 6
12 6 7 9 10 8 7 8 9 10 11 12
13 Weight 38..0 Transverse Section D.o
2,997
14 D.o D.o
2,743



Scale, One Inch to a Foot.

THE foregoing Experiments on Velocity, were ſucceeded by another Series, calculated to aſcertain the reſpective Degrees of Stability, or Power to reſiſt the Preſſure of the Wind, in carrying Sail, on Bodies of different Forms.

Four Figures were conſtructed, whoſe ſpecific Capacity, and Weight, were preciſely equal, though their Forms differed in the Extremes, as appears by Plate 2. Their Materials were ſimilar in Quality, and they were balanced in ſuch Manner, as to be turned upon their reſpective Centers of Gravity, by Application of the ſmalleſt Power: In ſhort, they were perfectly homogenous. A ſmall Pivot was driven into either End of the

Figures, at the Point, where the perpendicular middle Line interſects the Line of Flotation. The Figures were then floated in a large Back, having two ſmall Hooks driven into one Side of it, at the Edge of the Water, the Diſtance between the two Hooks being equal to the Length of the Figures. Two ſmall Lines were paſſed from the Pivots on the End of the Figures, to the correſponding Hooks on the Side of the Back, to counteract the Inclination which the Weight on the oppoſite Side of the Back had to draw the Figures over to that Side. This Weight was attached to a Line made faſt at the Top of a Staff, erected by Way of Maſt, in the Center of the Figures, and paſſed over a Pulley elevated on a ſimilar Staff attached to the Side of the Back, oppoſite to that on which the before-deſcribed Hooks, &c. were placed; this Pulley being ſuſpended in a Groove, to admit of depreſſion, as the Figures became heeled or inclined, and conſequently to be on a Level with the Top of the Maſt when in that Poſition. Thus the Power being always horizontally applied, was ſimilar, in Effect, to the Force of the Wind. The Reſult of this Series was, as appears by the Tables in Plate 2, that, with the leſſer Weights, the reſpective Figures exceeded each other in Stability uniformly as they ſtand numbered.

That Fig. 1 exceeded Fig. 2 in Stability, 'till the applied Weights amounted to about 13 ½ lbs, after which the Exceſs was with Fig. 2. That Fig. 3 was, with every Weight, inferior in Stability to Fig. 1 and 2; and Fig. 4 was, with every Weight, inferior to all the Others. From hence it appears, that the Form of a Midſhip Body, beſt adapted for Stability only, is a flat Bottom, with perpendicular Sides; and, that the next beſt adapted, is a Semicircle. But as there exiſts much Difficulty in conſtructing the former with ſufficient

Strength,

Strength, beſides its being ill adapted to heavy Seas, as, by the ſudden deſcent in pitching, the Bottom will ſtrike the Water, nearly at right Angles, and ſuſtain, thereby, a tremendous Shock. And, as the latter ſeems to be too inclinable to tranſverſe Oſcillation, or Rolling, and alſo to be deficient in Capacity for many Services, I am of Opinion, that a Midſhip Body, of a compounded Form, is moſt applicable to general Purpoſes.

An Experiment was alſo made on the ſame Figures, to aſcertain the reſpective Degrees of Counter-oſcillation, by cutting the Line when the Figures were at their utmoſt Inclination; viz. when the Top of the Side to Leeward was even with the Surface of the Water. The Reſult of this Experiment was nearly in an inverſe Ratio to the Stability. The Counter-inclination produced by the ſudden Ceſſation of the Power of the Weight being in No. 1, $\overset{\circ}{3}3\text{-}\overset{\prime}{0}$ No. 2, $\overset{\circ}{2}9\text{-}\overset{\prime}{0}$ No. 3, $\overset{\circ}{2}7\text{-}\overset{\prime}{0}$ and No. 4, $2\overset{\circ}{3}\text{-}\overset{\prime}{3}0$

I ſhall conclude with flattering myſelf, that ſome uſeful Ideas may ariſe from a due Conſideration of the Reſult of theſe Experiments, with my haſty Obſervations thereon; but, ſhould they convey to the Conſtructors of Shipping, and the Public, even a ſingle Hint towards Improvement, I ſhall conſider the Expence and Trouble I have beſtowed, as amply compenſated: And, if You, Gentlemen of the Society, will, at Your Leiſure, honor theſe Sheets with Peruſal, I ſhall conſider it as an additional Obligation conferred on,

GENTLEMEN,

Your very Obedient

Humble Servant,

Charles Gore.

Plate No. 2.

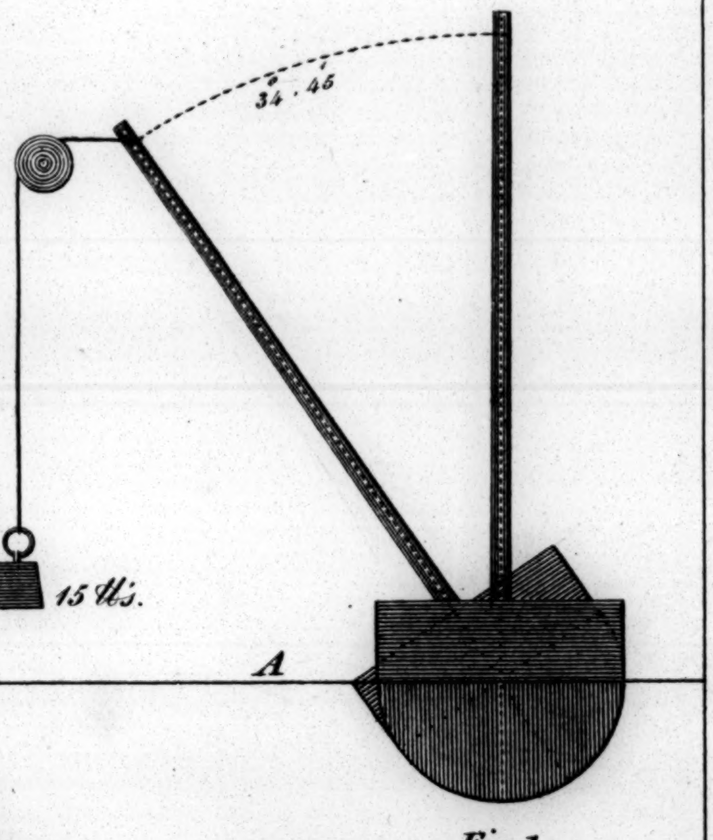


Fig. 1.

Weight.	Degrees.
℔	° '
1	2.48
3	8.30
6	16.42
9	23.45
12	29.40
15	34.45

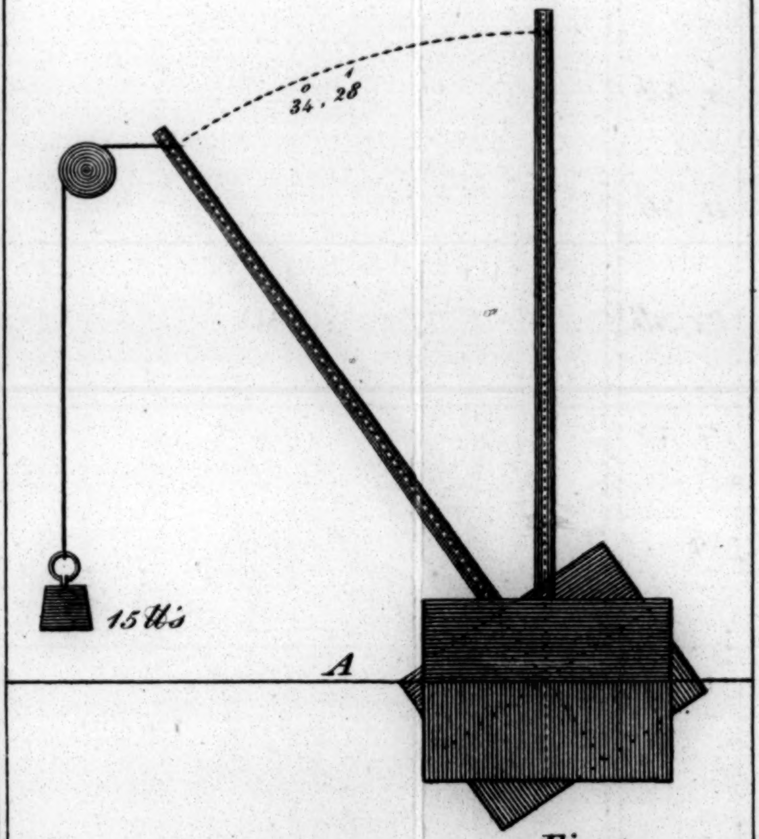


Fig. 2.

Weight.	Degrees.
℔	° '
1	3,15
3	9,35
6	18,03
9	24,58
12	30,10
15	34,28

A.A.A.A Line of Flotation

NB. The Figures

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15
35
03
58
10
28

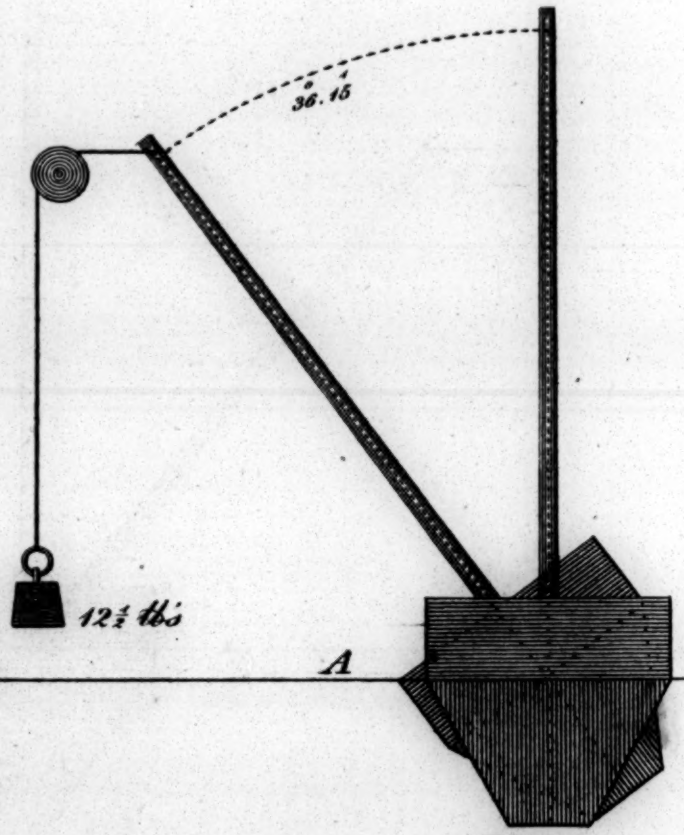

Fig. 3.

Weight.	Degrees.
℔	° ′
1	3, 20
3	10, 03
6	19, 33
9	27, 57
12	35, 12
12½	36, 15

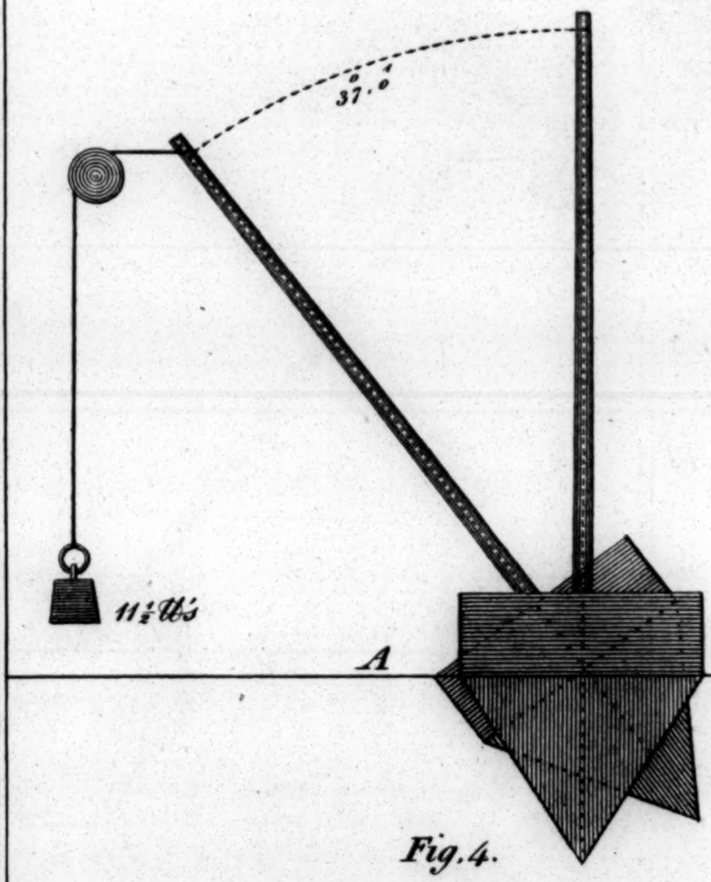

Fig. 4.

Weight.	Degrees.
℔	° ′
1	3, 58
3	11, 36
6	22, 38
9	31, 55
11	36, 15
11½	37, 0

igures were three feet in Length and two in Breadth.